PRACTICAL NO. 7

Implementation of Virtual Machine using Cloud Computing Concepts

1. Introduction:

According to **NIST**, “Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources … that can be rapidly provisioned and released with minimal management effort.”
(Ref: *NIST SP 800-145: The NIST Definition of Cloud Computing*.)

Cloud services are categorized as:

- **IaaS** – Provides infrastructure components like VMs, storage, and networks.
- **PaaS** – Provides runtime environments for development.
- **SaaS** – Provides complete applications to end users over the internet.

Virtualization Concept:

Virtualization is the process of abstracting physical hardware into multiple logical units called **Virtual Machines (VMs)**. Each VM runs its own operating system and applications while sharing the same physical hardware through a **hypervisor**.
This abstraction layer enables **resource isolation**, **load balancing**, and **efficient utilization** of cloud infrastructure.

2. Objective:

The primary objectives of this experiment are:

- To understand and implement virtualization using **Cloud Computing concepts**.
- To create and configure a **Virtual Machine (VM)** on **Amazon Web Services (AWS)** cloud platform.

3. Tools and Technologies:

Component	Description / Example
Cloud Platform	Amazon Web Services (AWS)
Service Used	Amazon EC2 (Elastic Compute Cloud)
Operating System (OS)	Ubuntu 22.04 LTS / Windows Server 2019
Web Browser	Google Chrome / Microsoft Edge (latest version)
SSH Client / RDP	PuTTY (Windows) or Terminal (Linux/Mac)
Key Management	AWS Key Pair (.pem file)
Storage	Amazon EBS (Elastic Block Store)
Network	AWS VPC (Virtual Private Cloud), Security Groups
Optional Monitoring	AWS CloudWatch

4. System Requirements Hardware and software:

Processor	Dual-core (Intel/AMD)
RAM	4 GB or higher
Operating System	Windows 10/11, macOS, or Linux
Internet Connection	Stable broadband (minimum 2 Mbps)
AWS Account	Free-tier account enabled
Software Tools	Web browser, PuTTY/Terminal, and PDF viewer

5. Implementation Steps:

Step 1: Sign in to AWS Console

- Log in to https://aws.amazon.com/console.
- From the AWS Management Console, navigate to EC2 (Elastic Compute Cloud) service.

Step 2: Launch a New Instance

1. Click Launch Instance.
2. Enter an Instance Name (e.g., CloudLab-VM).
3. Under Application and OS Images (AMI), choose Ubuntu Server 22.04 LTS (Free-tier eligible).
4. Under Instance Type, choose t2.micro (1 vCPU, 1 GB RAM).

Step 3: Configure Storage and Network

- Disk Size (EBS Volume): Set to 30 GB (gp3 SSD).
- Network: Choose the default VPC and subnet.
- Enable Auto-assign Public IP.
- Security Group: Create a new one allowing:
    - Inbound Rule: SSH, TCP, Port 22, Source = My IP
    - Outbound Rule: All traffic (default).

Step 4: Key Pair Configuration

- Choose “Create a new key pair.”
- Download the .pem file securely (used for SSH connection).

Step 5: Launch the Instance

- Review all settings (OS, instance type, disk, public IP, security group).
- Click Launch Instance.
- Wait for status → Running.

6. Advantages:

- **Scalability** Easily increase or decrease computing resources based on demand.
- **Cost Efficiency** Pay-as-you-go pricing reduces upfront infrastructure costs.
- **Flexibility** Support for multiple OS types and configurations.
- **High Availability** AWS provides multiple regions and zones for redundancy.
- **Security** Configurable firewalls, IAM roles, and encryption for protection.
- **Automation** AWS SDKs, APIs, and CloudFormation allow automated deployments.

7. Conclusion:

- By creating an EC2 instance, we explored the core principles of Infrastructure as a Service (IaaS) — provisioning, configuration, and verification of a virtual machine.
- The practical exercise validated key cloud computing concepts such as elastic resource allocation, on-demand provisioning, and secure network configuration.
- Hence, the successful deployment of a VM on AWS illustrates the fundamental working of cloud-based virtualization platforms.

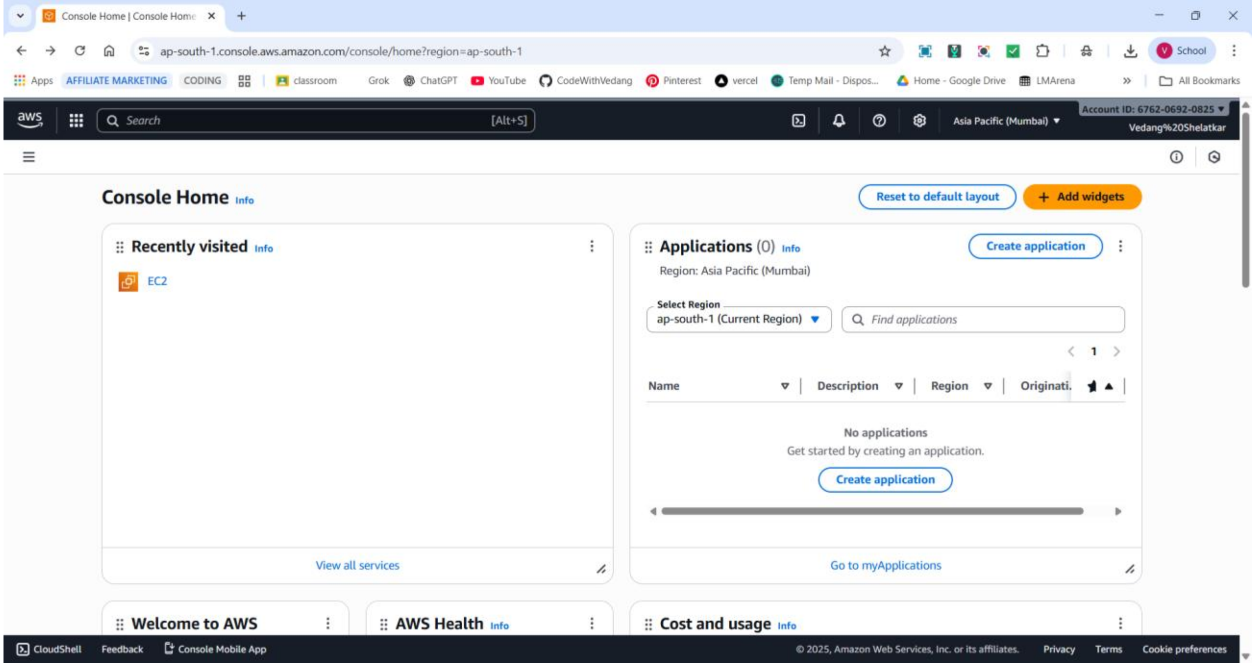
8. References:

1. Dac Nhuong Le, Cloud Computing and Virtualization, Wiley, 2022.
2. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill, 2013.
3. National Institute of Standards and Technology (NIST), The NIST Definition of Cloud Computing (SP 800-145), 2011.
4. AWS Documentation – Getting Started with Amazon EC2, https://docs.aws.amazon.com/ec2
5. AWS Documentation – Amazon EC2 Instance Types, https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/instance-types.html
6. BuzzClan, Virtualization in Cloud Computing – The Ultimate Guide, https://buzzclan.com/cloud/virtualization-in-cloud-computing/

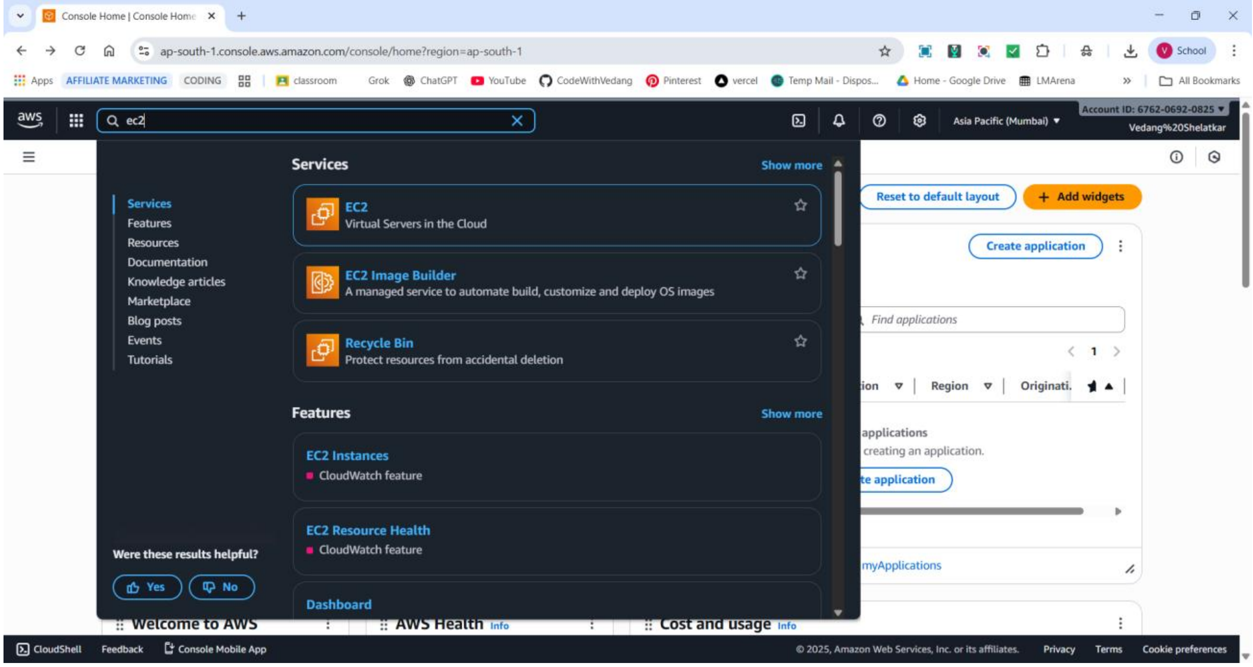
Exercise:

1. Create a virtual machine (VM) on any cloud provider (AWS/Azure/GCP) of your choice with the specifications: Operating System, VM Type, Disk Size, Public IP, Network Rules. Once created, verify that the VM is running and submit a screenshot of the instance details and a brief description of the steps you followed.

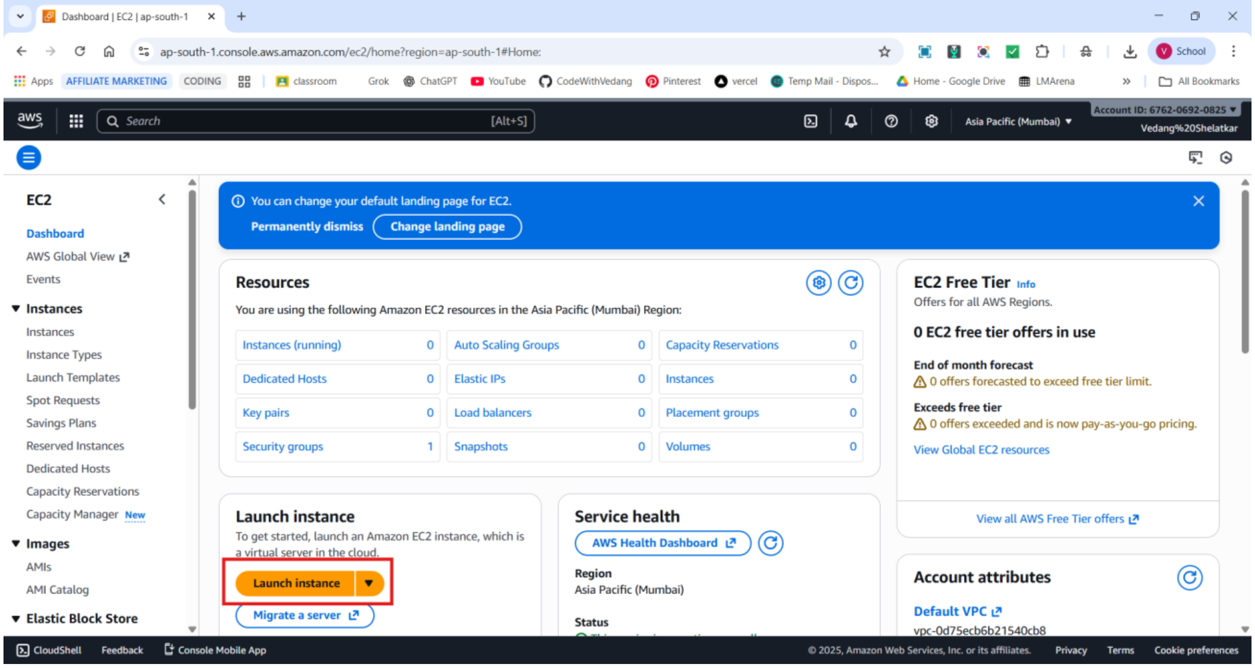
STEP 1: Log in to AWS Management Console



STEP 2: Open EC2 Service from AWS Dashboard



STEP 3: Launch a New EC2 Instance



You can change your default landing page for EC2.

Resources

You are using the following Amazon EC2 resources in the Asia Pacific (Mumbai) Region:

Instances (running)	0	Auto Scaling Groups	0	Capacity Reservations	0
Dedicated Hosts	0	Elastic IPs	0	Instances	0
Key pairs	0	Load balancers	0	Placement groups	0
Security groups	1	Snapshots	0	Volumes	0

EC2 Free Tier Info

Offers for all AWS Regions.

0 EC2 free tier offers in use

End of month forecast

⚠ 0 offers forecasted to exceed free tier limit.

Exceeds free tier

⚠ 0 offers exceeded and is now pay-as-you-go pricing.

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Service health

Region

Asia Pacific (Mumbai)

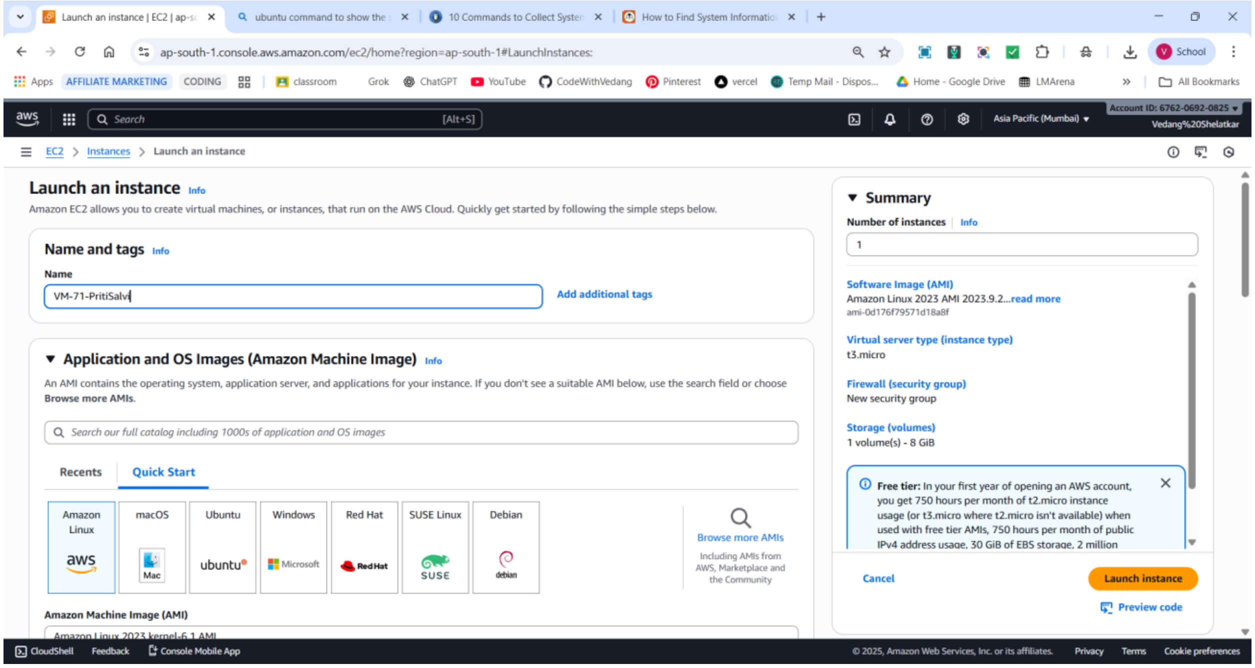
Status

Account attributes

Default VPC

vpc-0d75ecb6b21540cb8

Step 4: Select Operating System (AMI) – Ubuntu Server 22.04 LTS



Launch an instance Info

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

Name and tags Info

Name: VM-71-PritiSalvi

Application and OS Images (Amazon Machine Image) Info

An AMI contains the operating system, application server, and applications for your instance. If you don't see a suitable AMI below, use the search field or choose Browse more AMIs.

Search our full catalog including 1000s of application and OS images

Amazon Machine Image (AMI)

Amazon Linux 2023 kernel-6.1 AMI

Summary

Number of instances: 1

Software Image (AMI)

Amazon Linux 2023 AMI 2023.9.2...read more

ami-0d176f79571d18a8f

Virtual server type (instance type)

t3.micro

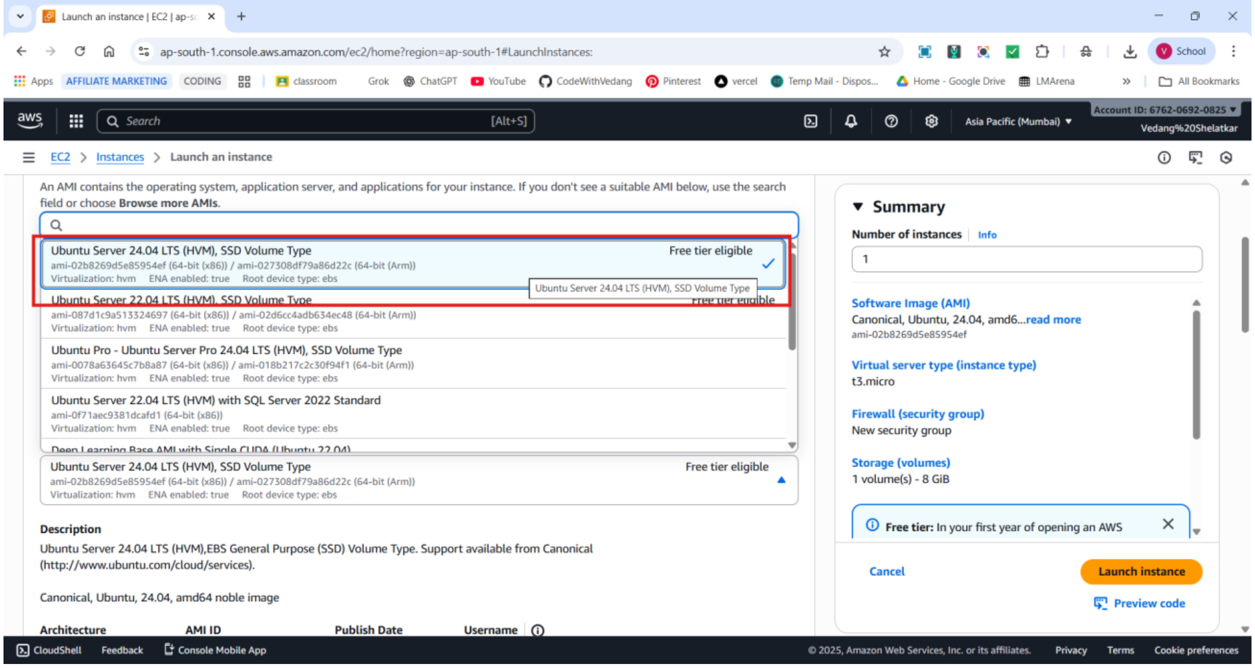
Firewall (security group)

New security group

Storage (volumes)

1 volume(s) - 8 GiB

Free tier: In your first year of opening an AWS account, you get 750 hours per month of t2.micro instance usage (or t3.micro where t2.micro isn't available) when used with free tier AMIs, 750 hours per month of public IPv4 address usage, 30 GiB of EBS storage, 2 million


Launch an instance | EC2 | ap-s
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
aws
Search [Alt+S]
Asia Pacific (Mumbai)
Account ID: 6762-0692-0825
Vedang%20Shelatkar
EC2 > Instances > Launch an instance
CloudShell
Feedback
Console Mobile App
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An AMI contains the operating system, application server, and applications for your instance. If you don't see a suitable AMI below, use the search field or choose **Browse more AMIs**.

Ubuntu Server 24.04 LTS (HVM), SSD Volume Type — Free tier eligible ✓
ami-02b8269d5e85954ef (64-bit (x86)) / ami-027308df79a86d22c (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

Ubuntu Server 22.04 LTS (HVM), SSD Volume Type — Free tier eligible
ami-087d1c9a513324697 (64-bit (x86)) / ami-02d6cc4adb634ec48 (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

Ubuntu Pro - Ubuntu Server Pro 24.04 LTS (HVM), SSD Volume Type
ami-0078a63645c7b8a87 (64-bit (x86)) / ami-018b217c2c30f94f1 (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

Ubuntu Server 22.04 LTS (HVM) with SQL Server 2022 Standard
ami-0f71aec9381dcafd1 (64-bit (x86))
Virtualization: hvm ENA enabled: true Root device type: ebs

Deep Learning Base AMI with Single CUDA (Ubuntu 22.04)

Ubuntu Server 24.04 LTS (HVM), SSD Volume Type — Free tier eligible
ami-02b8269d5e85954ef (64-bit (x86)) / ami-027308df79a86d22c (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

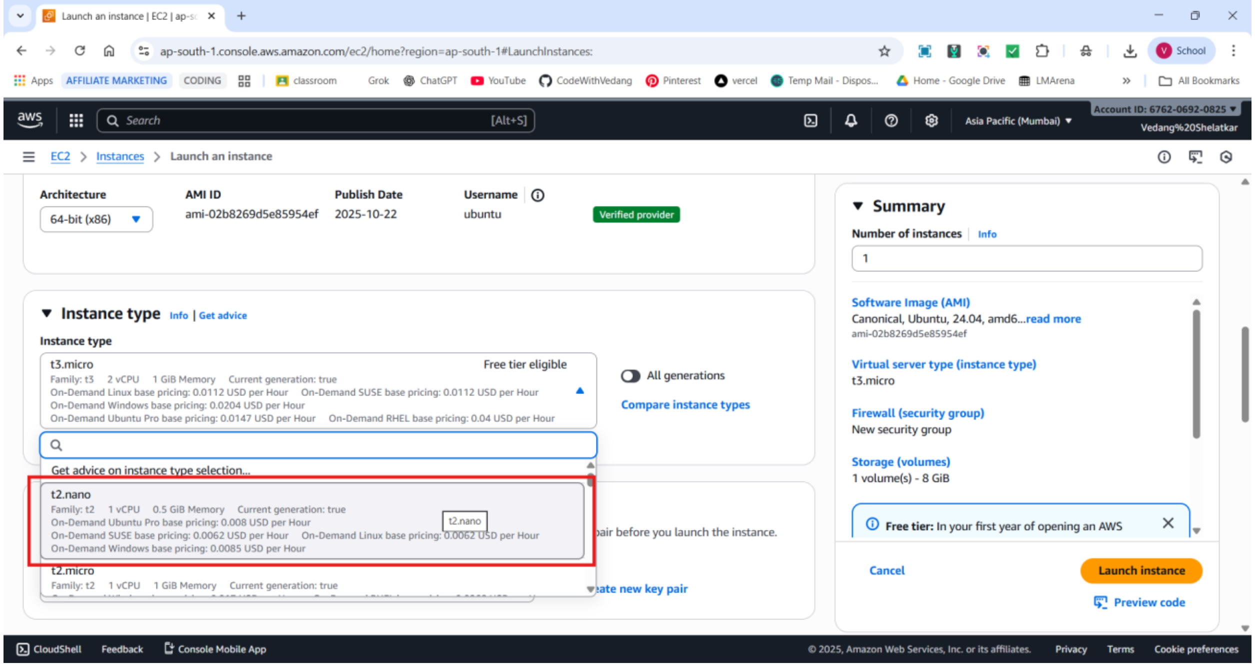
Description
Ubuntu Server 24.04 LTS (HVM),EBS General Purpose (SSD) Volume Type. Support available from Canonical (http://www.ubuntu.com/cloud/services).

Canonical, Ubuntu, 24.04, amd64 noble image

Architecture **AMI ID** **Publish Date** **Username**

Summary
Number of instances: 1
Software Image (AMI): Canonical, Ubuntu, 24.04, amd6...read more — ami-02b8269d5e85954ef
Virtual server type (instance type): t3.micro
Firewall (security group): New security group
Storage (volumes): 1 volume(s) - 8 GiB
Free tier: In your first year of opening an AWS
Cancel | Launch instance | Preview code

Step 5: Choose Instance Type– t2.nano


Launch an instance | EC2 | ap-s
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
aws
Search [Alt+S]
Asia Pacific (Mumbai)
Account ID: 6762-0692-0825
Vedang%20Shelatkar
EC2 > Instances > Launch an instance
Verified provider
All generations
Compare instance types
CloudShell
Feedback
Console Mobile App
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Architecture	AMI ID	Publish Date	Username
64-bit (x86)	ami-02b8269d5e85954ef	2025-10-22	ubuntu

Instance type Info | Get advice

Instance type

t3.micro — Free tier eligible
Family: t3 2 vCPU 1 GiB Memory Current generation: true
On-Demand Linux base pricing: 0.0112 USD per Hour On-Demand SUSE base pricing: 0.0112 USD per Hour
On-Demand Windows base pricing: 0.0204 USD per Hour
On-Demand Ubuntu Pro base pricing: 0.0147 USD per Hour On-Demand RHEL base pricing: 0.04 USD per Hour

Get advice on instance type selection...

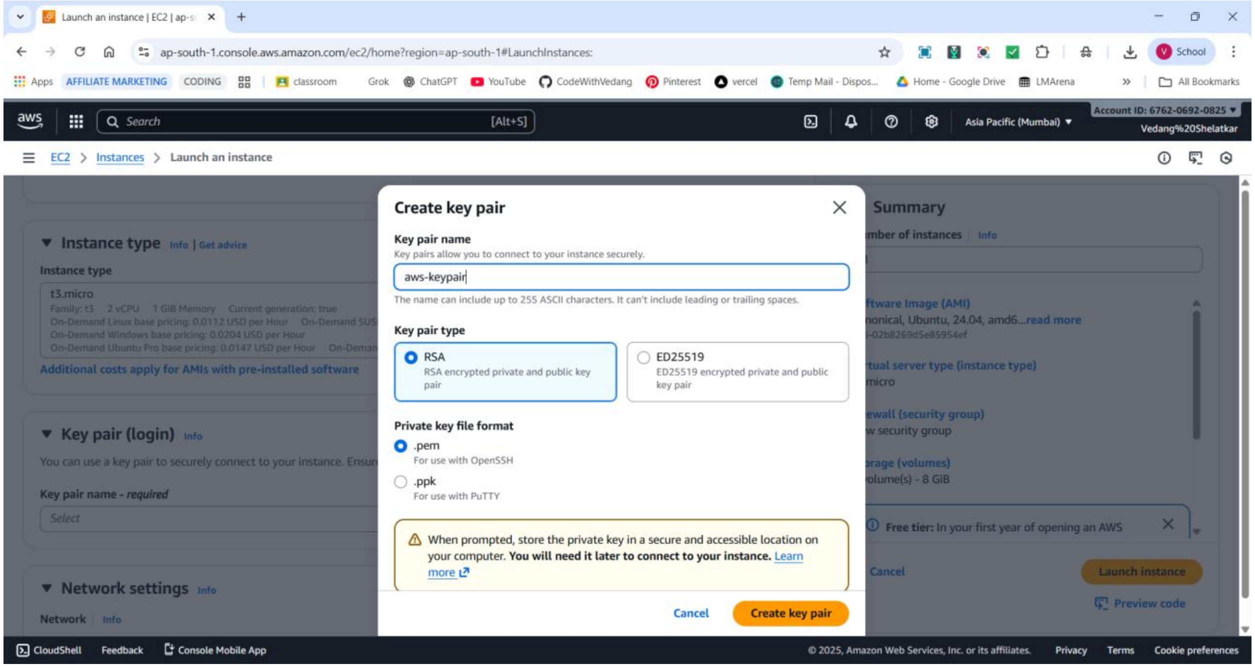
t2.nano
Family: t2 1 vCPU 0.5 GiB Memory Current generation: true
On-Demand Ubuntu Pro base pricing: 0.008 USD per Hour
On-Demand SUSE base pricing: 0.0062 USD per Hour On-Demand Linux base pricing: 0.0062 USD per Hour
On-Demand Windows base pricing: 0.0085 USD per Hour

t2.micro
Family: t2 1 vCPU 1 GiB Memory Current generation: true

...air before you launch the instance.
...ate new key pair

Summary
Number of instances: 1
Software Image (AMI): Canonical, Ubuntu, 24.04, amd6...read more — ami-02b8269d5e85954ef
Virtual server type (instance type): t3.micro
Firewall (security group): New security group
Storage (volumes): 1 volume(s) - 8 GiB
Free tier: In your first year of opening an AWS
Cancel | Launch instance | Preview code

STEP 6: Create Key Pair



Create key pair

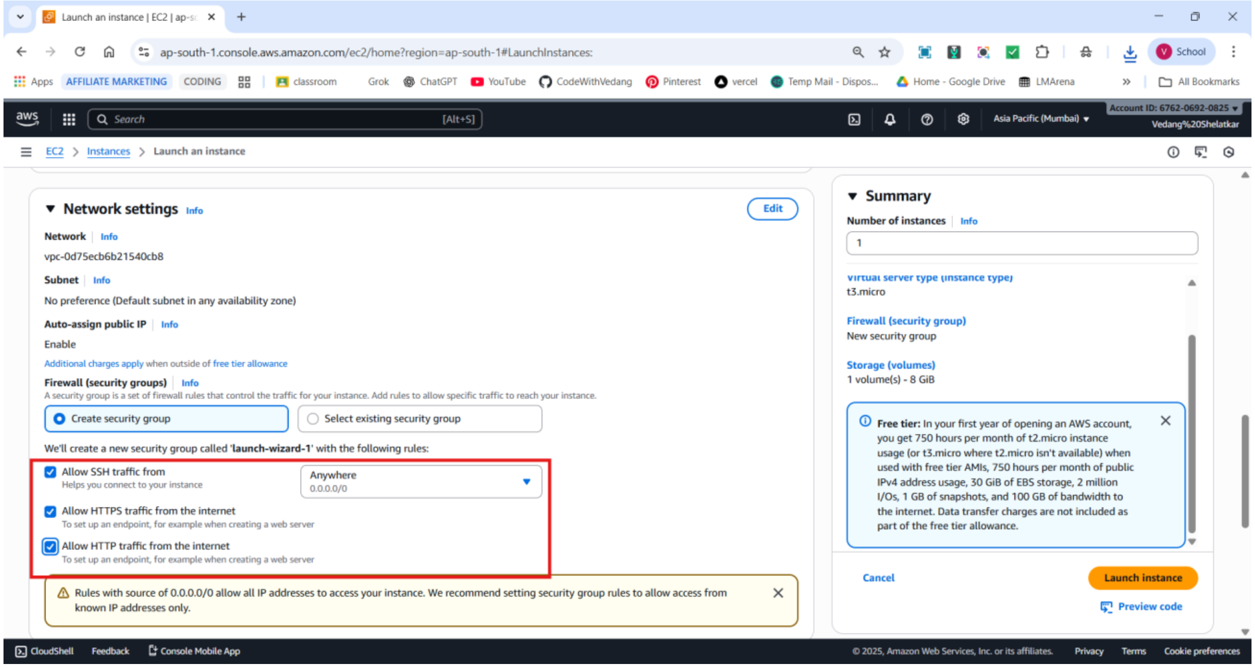
Key pair name
Key pairs allow you to connect to your instance securely.
aws-keypair
The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.

Key pair type
● RSA — RSA encrypted private and public key pair
○ ED25519 — ED25519 encrypted private and public key pair

Private key file format
● .pem — For use with OpenSSH
○ .ppk — For use with PuTTY

⚠ When prompted, store the private key in a secure and accessible location on your computer. **You will need it later to connect to your instance.** Learn more

STEP 7: Setup Network Configurations



Network settings

Network: vpc-0d75ecb6b21540cb8

Subnet: No preference (Default subnet in any availability zone)

Auto-assign public IP: Enable

Additional charges apply when outside of free tier allowance

Firewall (security groups)
A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

● Create security group ○ Select existing security group

We'll create a new security group called **'launch-wizard-1'** with the following rules:

☑ Allow SSH traffic from — Anywhere 0.0.0.0/0
Helps you connect to your instance

☑ Allow HTTPS traffic from the internet
To set up an endpoint, for example when creating a web server

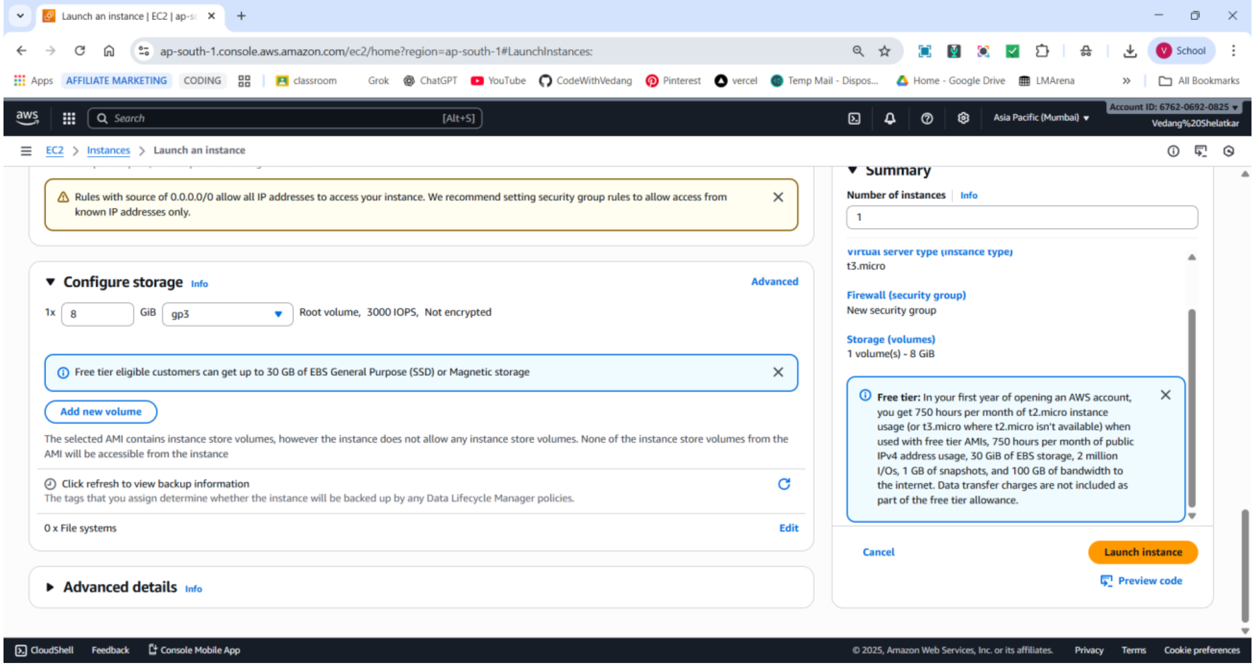
☑ Allow HTTP traffic from the internet
To set up an endpoint, for example when creating a web server

⚠ Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

Summary
Number of instances: 1
Virtual server type (instance type): t3.micro
Firewall (security group): New security group
Storage (volumes): 1 volume(s) - 8 GiB

Free tier: In your first year of opening an AWS account, you get 750 hours per month of t2.micro instance usage (or t3.micro where t2.micro isn't available) when used with free tier AMIs, 750 hours per month of public IPv4 address usage, 30 GiB of EBS storage, 2 million I/Os, 1 GB of snapshots, and 100 GB of bandwidth to the internet. Data transfer charges are not included as part of the free tier allowance.

STEP 8: Configure Storage


Launch an instance | EC2 | ap-s
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
Search [Alt+S]
Asia Pacific (Mumbai)
Account ID: 6762-0692-0825
Vedang%20Shelatkar
EC2 > Instances > Launch an instance
CloudShell Feedback Console Mobile App
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Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

Configure storage Info Advanced

1x 8 GiB gp3 Root volume, 3000 IOPS, Not encrypted

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage

Add new volume

The selected AMI contains instance store volumes, however the instance does not allow any instance store volumes. None of the instance store volumes from the AMI will be accessible from the instance

Click refresh to view backup information
The tags that you assign determine whether the instance will be backed up by any Data Lifecycle Manager policies.

0 x File systems Edit

Advanced details Info

Summary

Number of instances Info
1

Virtual server type (instance type)
t3.micro

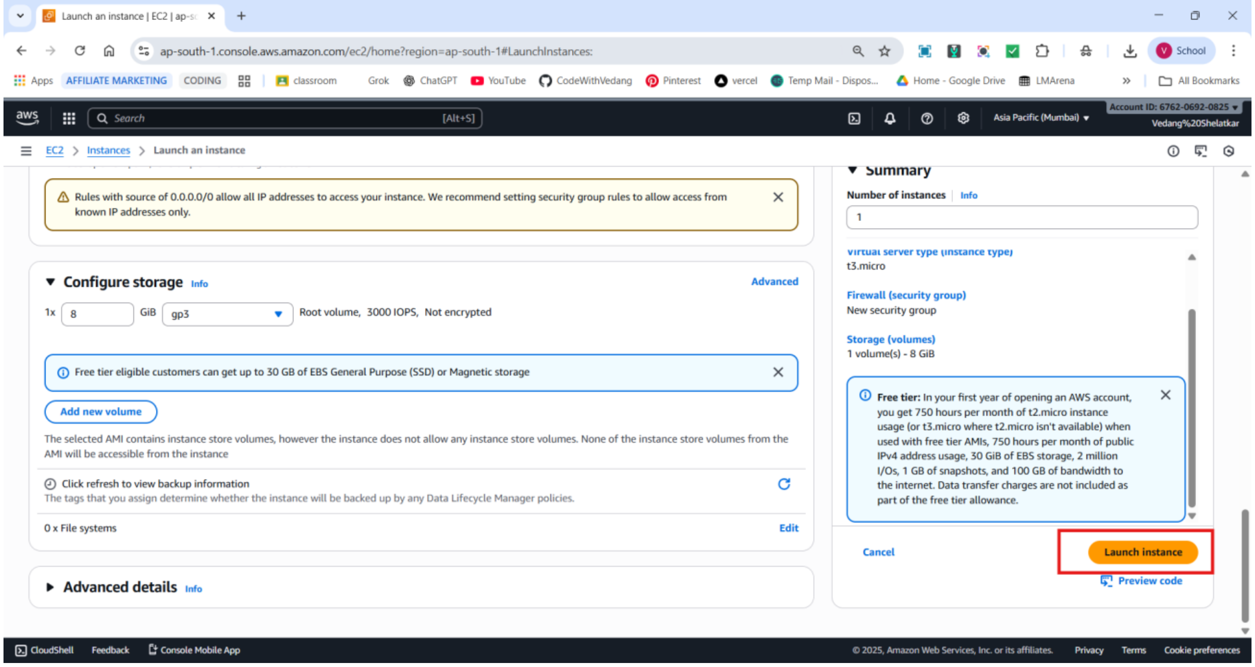
Firewall (security group)
New security group

Storage (volumes)
1 volume(s) - 8 GiB

Free tier: In your first year of opening an AWS account, you get 750 hours per month of t2.micro instance usage (or t3.micro where t2.micro isn't available) when used with free tier AMIs, 750 hours per month of public IPv4 address usage, 30 GiB of EBS storage, 2 million I/Os, 1 GB of snapshots, and 100 GB of bandwidth to the internet. Data transfer charges are not included as part of the free tier allowance.

Cancel Launch instance Preview code

STEP 9: Launch the Instance


Launch an instance | EC2 | ap-s
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
Search [Alt+S]
Asia Pacific (Mumbai)
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Vedang%20Shelatkar
EC2 > Instances > Launch an instance
CloudShell Feedback Console Mobile App
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Advanced details Info

Summary

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Virtual server type (instance type)
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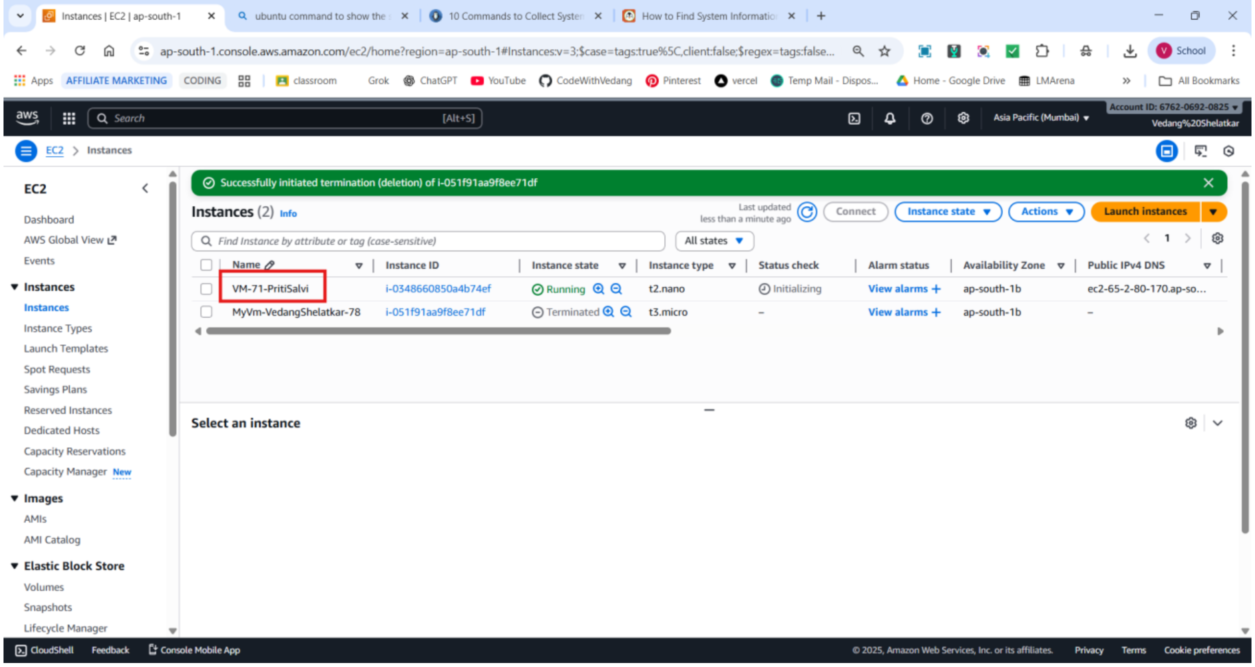
Cancel Launch instance Preview code

STEP 10: Verify Instance State – Running



ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#Instances:v=3;$case=tags:true%5C,client:false;$regex=tags:false...

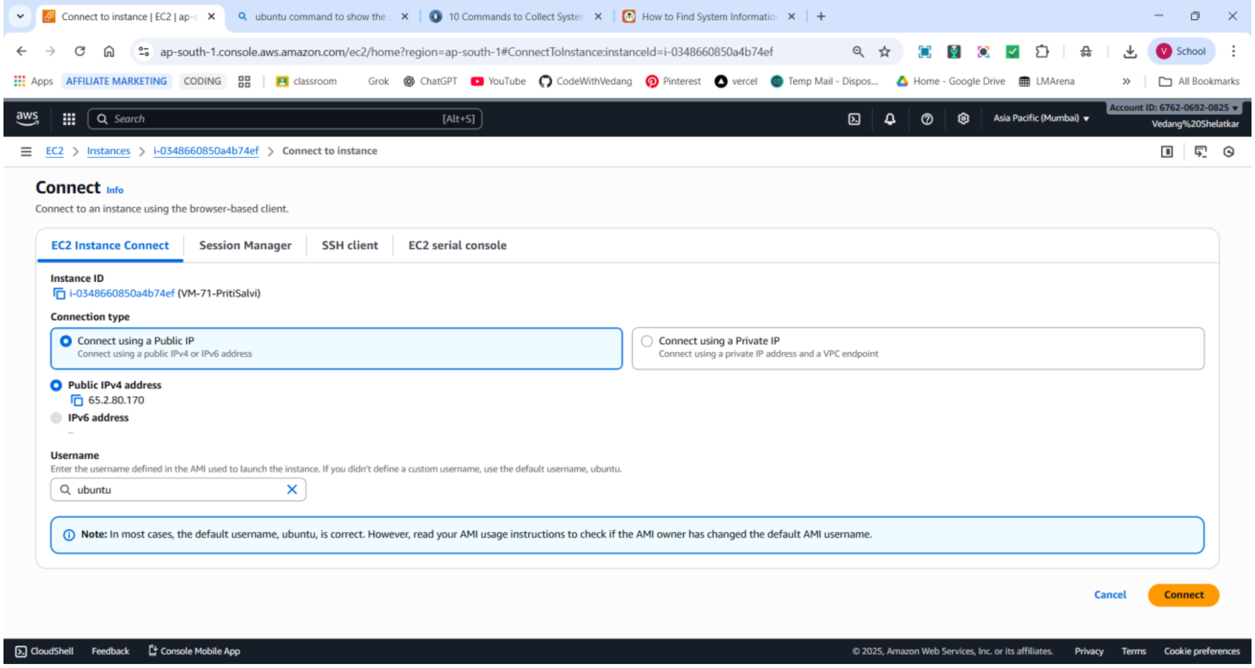
EC2 > Instances

Successfully initiated termination (deletion) of i-051f91aa9f8ee71df

Instances (2)

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS
VM-71-PritiSalvi	i-0348660850a4b74ef	Running	t2.nano	Initializing	View alarms +	ap-south-1b	ec2-65-2-80-170.ap-so...
MyVm-VedangShelatkar-78	i-051f91aa9f8ee71df	Terminated	t3.micro	–	View alarms +	ap-south-1b	–

STEP 11: Connect to instance :



ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#ConnectToInstance:instanceId=i-0348660850a4b74ef

EC2 > Instances > i-0348660850a4b74ef > Connect to instance

Connect

Connect to an instance using the browser-based client.

EC2 Instance Connect | Session Manager | SSH client | EC2 serial console

Instance ID
i-0348660850a4b74ef (VM-71-PritiSalvi)

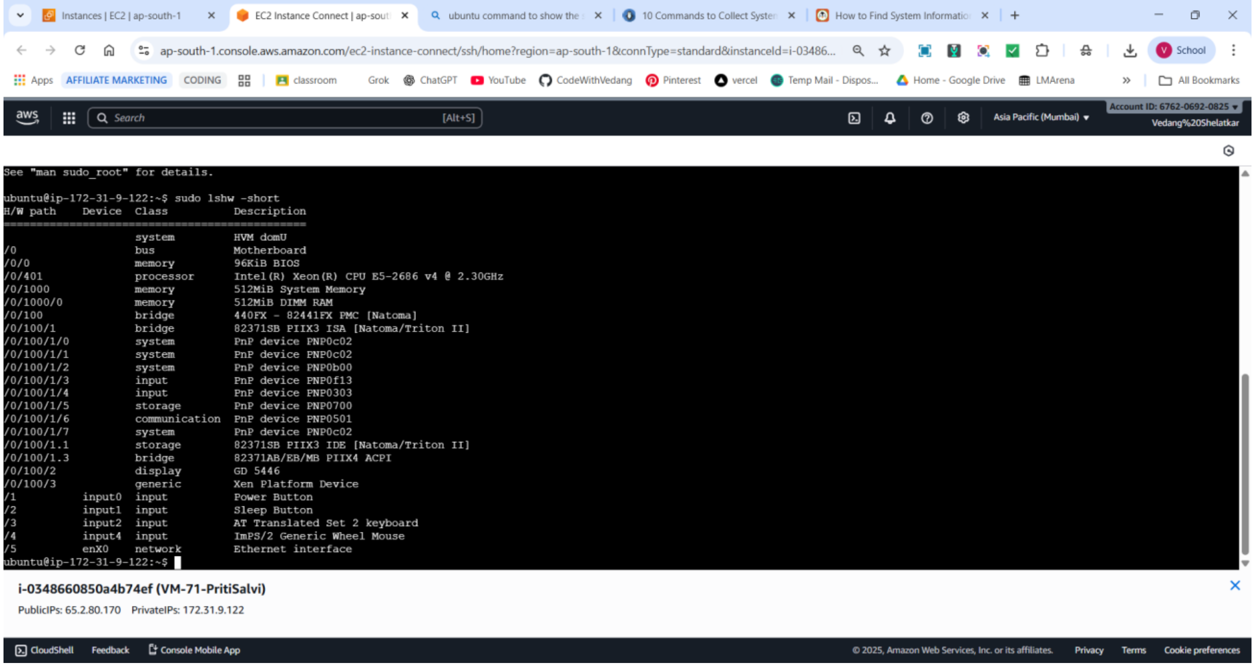
Connection type
● Connect using a Public IP – Connect using a public IPv4 or IPv6 address
○ Connect using a Private IP – Connect using a private IP address and a VPC endpoint

● Public IPv4 address
65.2.80.170
○ IPv6 address
–

Username
Enter the username defined in the AMI used to launch the instance. If you didn't define a custom username, use the default username, ubuntu.
ubuntu

Note: In most cases, the default username, ubuntu, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI username.

STEP 12: Execute Command to Check System Type



```
See "man sudo_root" for details.

ubuntu@ip-172-31-9-122:~$ sudo lshw -short
H/W path    Device  Class          Description
==============================================
                    system         HVM domU
/0                  bus            Motherboard
/0/0                memory         96KiB BIOS
/0/401              processor      Intel(R) Xeon(R) CPU E5-2686 v4 @ 2.30GHz
/0/1000             memory         512MiB System Memory
/0/1000/0           memory         512MiB DIMM RAM
/0/100              bridge         440FX - 82441FX PMC [Natoma]
/0/100/1            bridge         82371SB PIIX3 ISA [Natoma/Triton II]
/0/100/1/0          system         PnP device PNP0c02
/0/100/1/1          system         PnP device PNP0c02
/0/100/1/2          system         PnP device PNP0b00
/0/100/1/3          input          PnP device PNP0f13
/0/100/1/4          input          PnP device PNP0303
/0/100/1/5          storage        PnP device PNP0700
/0/100/1/6          communication  PnP device PNP0501
/0/100/1/7          system         PnP device PNP0c02
/0/100/1.1          storage        82371SB PIIX3 IDE [Natoma/Triton II]
/0/100/1.3          bridge         82371AB/EB/MB PIIX4 ACPI
/0/100/2            display        GD 5446
/0/100/3            generic        Xen Platform Device
/1          input0  input          Power Button
/2          input1  input          Sleep Button
/3          input2  input          AT Translated Set 2 keyboard
/4          input4  input          ImPS/2 Generic Wheel Mouse
/5          enX0    network        Ethernet interface
ubuntu@ip-172-31-9-122:~$
```

i-0348660850a4b74ef (VM-71-PritiSalvi)

PublicIPs: 65.2.80.170 PrivateIPs: 172.31.9.122

Instances | EC2 | ap-south-1
EC2 Instance Connect | ap-south
ubuntu command to show the
10 Commands to Collect System
How to Find System Information
ap-south-1.console.aws.amazon.com/ec2-instance-connect/ssh/home?region=ap-south-1&connType=standard&instanceId=i-03486...
Search [Alt+S]
Asia Pacific (Mumbai)
Account ID: 6762-0692-0825
Vedang%20Shelatkar
CloudShell
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Console Mobile App
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Brief Description

I logged into the AWS Management Console and opened the EC2 service to create a new virtual machine. I selected Ubuntu Server 22.04 LTS as the operating system, chose the t2.nano instance type, and configured the required storage. A new key pair was created for secure access, and necessary network rules were set by allowing SSH in the security group. After reviewing the settings, I launched the instance and confirmed that it was running. Finally, I connected to the VM via SSH and executed system-information commands to verify that the machine was functioning correctly.

Conclusion

The virtual machine was successfully created and configured on AWS with the required specifications. All components OS, instance type, storage, and network rules—were set up properly, and the VM was verified to be running and accessible. This activity demonstrates the practical implementation of virtualization on a cloud platform.